Rjeas Research Journal in Engineering and Applied Sciences 1(5) 323-326 Rjeas
© Emerging Academy Resources (2012) (ISSN: 2276-8467)
www.emergingresource.org

BLEACHING OF CRUDE PALM KERNEL OIL USING ACTIVATED SNAIL SHELL

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ABSTRACT
The optimal bleaching parameters (temperature, contact time and adsorbent-to-crude PKO ratio) were determined for the decolouration of PKO using activated snail shell. different masses(1g, 2g and 3g) of activated pulverized snail shell were contacted with crude PKO at temperatures of 100OC, 120OC, 140OC, 160OC, 180OC and 200OC each for various contact times of 15min, 30min, 45min using a constant volume (20ml) of crude PKO sample in each case. The transmittance was measured using a spectrophotometer and the opacity and corresponding percentage colour reduction obtained in each case. The decolourizing effect of activated snail shell increased non-linearly with temperature. For the 20ml of crude PKO sample, 2g of activated snail gave the highest decolourization of 99.24% colour reduction at a temperature of 200OC and contact time of 45min. It is recommended to decolourise crude PKO using a ratio of 2:20 (g/ml) of activated snail shell to crude PKO at a temperature range of 180OC for 30min. This study will aid in the use of snail shell (a renewable resource) as an adsorbent in the bleaching of PKO in place of clay that is not renewable.

KEYWORDS: Snail Shell, Pulverised, Bleaching, Activated, Palm Kernel Oil.

INTRODUCTION

Palm kernel oil (PKO) is black viscous oil extracted from the kernel of oil palm. In its raw form it contains impurities such as organic pigments, oxidation metals, trace metals and traces of soap. For PKO to be used effectively, in most industrial processes, these impurities in it have to be extensively removed, thus making bleaching inevitable (Young, 1982; Macrae, 1993; Campbell et. al, 1999).

Bleaching involves a mass concentration of the colour pigment at the interface between the fluid and the bleaching agent. it is achieved as a result of intermolecular forces between molecules of solid and the substances adsorbed and is readily reversible (Richardson, Harke and Backhurst, 2002).

Adsorption bleaching is the most effective form of bleaching in which various adsorbents like carbon, silica gel, activated alumina and activated clay are used. The bleaching agent should be one that will change the tint of the oil without altering the chemical properties of the oil (Purvis, 1975; Parker 1987; www.fullerseearth.com, 2005).

Several bleaching agents, especially clays, have been studied in recent times for various bleaching temperatures and times. Clays that have been studied include acid, neutral and caustic activated clays (Brophy et. al 2004; Arumughan et. al 2004; Okwara and Osoka, 2006). Clays are non- renewable resources. This work studies the optimal conditions, with respect to bleaching temperatures and contact time (Malek and Farooq, 1997) for the use of snail shell (a renewable resource) as an adsorbent in the bleaching of PKO.

Snail shell is ideal for this process because it contains calcium carbonates (a carbonaceous material), and much of the substances volatilizes on heating, leaving behind a porous structure of carbon that usually contain some hydrogen. This may, then, be activated to further open up the pores and increase total surface area. In addition, it is also passive to crude PKO.

METHODOLOGY

Apparatus/Reagents

Stainless bowls, Stirrer, roller mill, 79 micrometer sieve and 0.5mol/dm3 dilute HCl, 0.3N NaOH, beam balance, heating furnace, stop watch, beaker, cylinder, filter paper, 85% H_3PO_4, centrifuge, electric oven with thermostat, spectrophotometer and test tubes.

PROCEDURE (Pulverization of Snail Shell)

The snail shell was first washed with water and sun dried. It was then manually broken into smaller pieces, washed with 0.5 mol/dm3 of dilute HCl, to remove other remaining forms of impurities and sun

dried, then it was ground into powder in a roller mill and finally sieved using 79 micrometer sieve.

PROCEDURE (Thermal Activation of the Snail shell)

60g of the sieved shell powder were heated in an electric furnace up to a temperature of 300OC for 30 minutes such that its colour changed from brown to white. It was then allowed to cool to room temperature.

PROCEDURE (Chemical Activation of the Snail shell)

50g of the thermally activated snail shell was reacted with 20ml of 85% H_3PO_4 in a beaker with continuous stirring for 2mins. The reaction was exothermic, and a gas with an offensive smell was given off. The reaction mixture was mixed with 25ml of distilled water to wash away the unreacted H_3PO_4, then it was filtered and the residue collected allowed to dry.

PROCEDURE (Bleaching of Crude PKO)

1) The transmittance of the crude PKO was first determined using spectrophotometer at 400nm to serve as a control. Different masses (1g, 2g, and 3g) of the activated snail shell were weighed out using the beam balance.

2) 1g, 2g and 3g respectively of the activated snail shell was transferred to a test tube and 20ml of crude PKO was added. The mixture was transferred to a test tube and 20ml of crude PKO was added. The mixture was well stirred and 0.3 NaOH was added to neutralise the fatty acid present in the oil. The mixture was poured into three different test tubes. The three samples were heated in an electric oven at a constant temperature of 100OC.

3) During the heating one of the sample test tubes were removed after 15min of heating, the next was removed after 30 min and the third sample remove after 45min. The samples were then labelled and centrifuged. After centrifugation, the top layer of each sample was taken to the spectrophotometer at 400nm to determine the transmittance. The transmittance of each sample at 100OC, 120OC, 140OC, 160OC, 180OC and 200OC respectively was recorded at the corresponding times of 15 min, 30min, and 45min respectively.

4) The corresponding transmittance using spectrophotometer at 400nm for each sample were recorded at 100OC, 120OC, 140OC, 160OC, 180OC and 200OC for each of the contact times of 15min, 30min and 45min.

5) The transmittance was inverted to obtain the opacity (Q) of the sample. The percentage colour reduction was obtained thus (Qc – Q)/Q*100.
Where Qc is the opacity of the control.

The results obtained for each mass were tabulated as shown in Tables 1, 2 and 3.

Table1: Percentage Colour Reduction using 1g of activated snail shell

Temperature (OC) → Contact time (mins)	100	120	140	160	180	200
15	50	75	80	87.5	88.89	90
30	50	75	94.74	96.67	98.08	98.75
45	50	75	95	97.22	98.57	99.04

Table 2: Percentage colour Reduction using 2g of activated snail shell

Temperature (OC) → Contact time (mins)	100	120	140	160	180	200
15	66.67	80	88.89	98	98.75	99.22
30	75	83.33	95	98.75	99.12	99.23
45	75	87.5	97.5	99.01	99.17	99.24

Table 3: Percentage colour Reduction using 3g of activated snail shell

Temperature (OC) → Contact time (mins)	100	120	140	160	180	200
15	80	85.71	90	98.69	99.09	99.22
30	80	87.5	95.45	98.99	99.17	99.23
45	83.33	88.89	97.92	99.04	99.17	99.23

Control: Transmittance of crude PKO = 0.01(Qc=100).

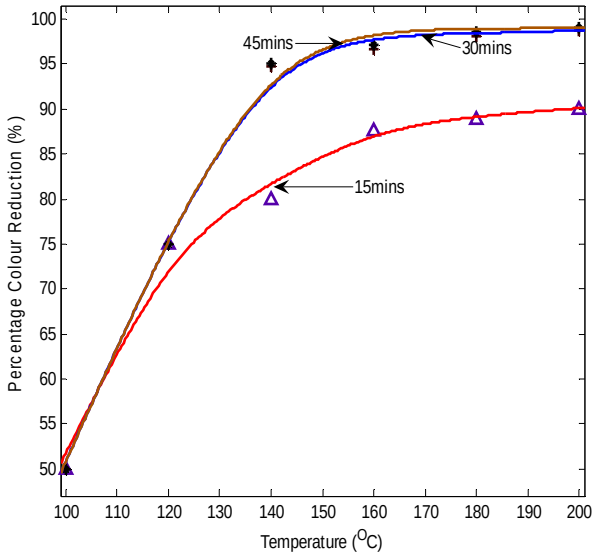

Fig. 1: Percentage Colour Reduction vs. Temperature for 1g Activated Snail Shell

RESULTS

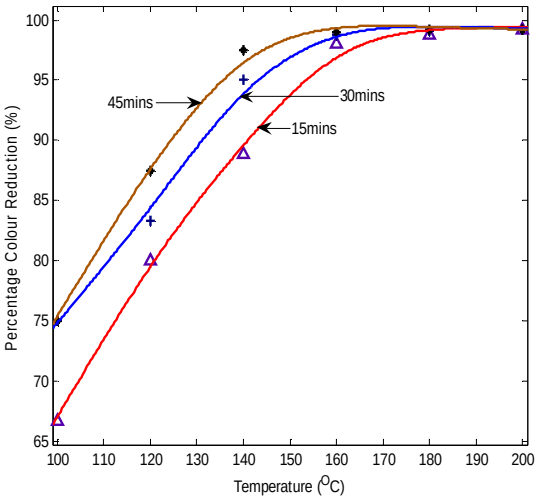

Fig. 2: Percenatge Colour Reduction vs. Temperature for 2g Activated Snail Shell

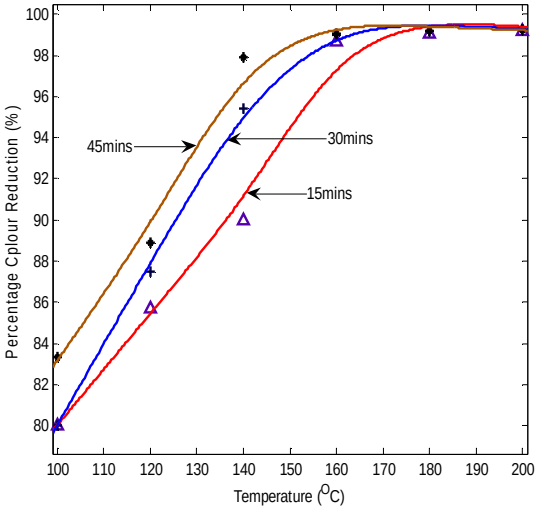

Fig. 3: Percenatge Colour Reduction vs. Temperature for 3g Activated Snail Shell

DISCUSSION

The variables considered in the bleaching process were mass of the activated snail shell, bleaching temperature and contact time. For 1g of the activated snail shell, the percentage colour reduction for contact time of 15min, 30min and 45min at bleaching temperature of 100-120^{O}C were the same. Significant differences were observed at temperature of 140OC and above. Increase in contact time from 15min to 30min has a significant impact on percentage colour reduction but increase in contact time from 30min to 45min is not justifiable as it offers no significant increase in percentage colour reduction.

Fig. 1 shows that at the same bleaching temperature, the percentage colour reduction increased with increasing contact time up to a temperature of about 180OC where contact increased time has no significant impact on percentage colour reduction.

For 2g of the activated snail shell, the curves are similar to those of 1g of activated snail shell, but Fig. 2 shows that higher bleaching is attained at lower temperature and at high contact times in comparison to that of 1g. There is also no significant colour reduction with respect to increase in contact time beyond 180OC.

For 3g of activated snail shell (Fig 3), the percentage colour reduction was almost the same at temperature of 100 – 120OC for different contact times, especially for 15 and 30mins. Again, the three curves for each of the contact times of 15min, 30min and 45min have the same shape. However, the percentage colour reduction increases at lower temperatures and at higher contact time, behaves as in the case where 2g is used.

At bleaching temperatures of 160-200OC, the curves for contact times 30min and 45min merged. This shows that the same bleaching effect is attained at these points. The percentage colour reduction obtained for 3g of snail shell gave no significant improvement over that 2g.

CONCLUSION

On analysis, the decolourizing effect of activated snail shell increases non-linearly with temperature. From the curves plotted, it was observed that as the contact time increased, the curve became less steeper, this means that higher decolourization rates was attained at lower temperatures as contact time increased.

For the 20ml crude sample used, 2g of activated snail shell gave the highest decolourization with 99.24% colour reduction at a temperature of 200OC and contact time of 45min, but this is not a significant improvement on 99.23% obtained in 30min.

It is recommended to decolorize crude PKO using a ratio of 2:20 (g/ml) of snail shell to crude PKO at a temperature of 180OC for 30min.

This work does not consider modelling of the kinetics of Bleaching Crude Palm Kernel Oil using activated Snail Shell, this is a limitation of the study that should be considered in further study.

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